

AMENDMENTS TO THE CLAIMS:

Claim 1 (Currently Amended). A method for treatment of groundwater in a subterranean formation and contaminated by the presence of dissolved volatile organic compounds (VOC's) which comprises:

establishing a well extending from the ground surface to a downhole location adjacent contaminated groundwater in the subterranean formation in order to allow withdrawal of a two-phase extract including an undissolved vapor phase and a liquid phase which comprises contaminated groundwater containing dissolved VOC's to the surface through the well for treatment;

conducting the two-phase extract from the downhole location through the well to the surface;

stripping the contaminated groundwater of the liquid phase of the extract by flowing the two-phase extract substantially concurrently through an orifice of an in-line stripper and rapidly expanding the flow of the two-phase extract in an adjacent a position downstream of the orifice of the inline stripper to induce transfer of VOC's from the contaminated groundwater of the two-phase extract to the undissolved vapor phase of the same flow of two-phase extract; and

separating the stripped extract into substantially liquid only and substantially vapor only process streams.

Claim 2 (Cancelled).

Claim 3 (Original). The method of Claim 1 further comprising separating VOC'S from the vapor process stream.

Claim 4 (Original). The method of Claim 1 wherein a subatmospheric pressure is imposed upon the groundwater within the well to promote withdrawal of the same to the surface and separation of VOC's.

Claim 5 (Original). The method of Claim 1 wherein the VOC'S comprise methyl tertiary butyl ether (MtBE).

Claim 6 (Original). The method of Claim 1 wherein at least about 80% of the VOC'S are stripped from the groundwater to the vapor phase in a single pass.

Claim 7 (Currently Amended). The method of Claim 1 wherein the extract is

accelerated while flowing through the orifice of in the inline stripper and then released into a relatively low pressure area downstream of the orifice to induce transfer of VOC's into the vapor phase.

Claim 8 (Previously Presented). The method of Claim 7 further comprising injecting compressed air into the extract flowing through the inline stripper.

Claim 9 (Previously Presented). The method of Claim 1 wherein the liquid and vapor phases are separated in a knockout vessel.

Claim 10 (Original). The method of Claim 1 further comprising repeating the step of stripping the contaminated groundwater by passing the stripped groundwater from the inline stripper through at least one additional inline stripper.

Claim 11 (Previously Presented). The method of Claim 1 further comprising recycling at least a portion of the stripped groundwater from the inline stripper to the extract withdrawn to the surface and restripping the same together with the extract in the inline stripper.

Claim 12 (Currently Amended). An apparatus for treatment of groundwater in a subterranean formation, said groundwater being contaminated by the presence of VOC's, including VOC's dissolved in the groundwater comprising:

at least one well extending from the ground surface to a downhole location adjacent contaminated groundwater in the subterranean formation in order to allow withdrawal of a two-phase extract including an undissolved vapor phase and a liquid phase wherein the liquid phase includes contaminated groundwater containing dissolved VOCs through the well to the surface through the well;

a stripper unit containing an inline stripper connected in flow communication with the well for stripping the dissolved VOC's from the contaminated groundwater of the liquid phase of the extract by flowing the two-phase extract substantially concurrently through an orifice of an in-line stripper and rapidly expanding the flow of the two-phase extract adjacent a position downstream of the orifice of the inline stripper to induce ~~means of expansion of the flow of the extract in the inline stripper inducing~~ transfer of VOC's from the groundwater of the two-phase extract to the undissolved vapor phase of the two-phase extract so that the material flow exiting the stripper contains a vapor phase enriched in VOC's and a liquid phase depleted in

VOC's;

means for causing a flow of the two-phase extract including contaminated groundwater from the subterranean formation into and through the well to the surface and through the inline stripper of the stripper unit; and

a collector connected in flow communication with the material exiting the inline stripper for collecting the liquid phase and the vapor phase in separate substantially liquid only and a substantially vapor only phases.

Claim 13 (Cancelled).

Claim 14 (Previously Presented). The apparatus of Claim 12 further comprising a vacuum source connected in flow communication with the well and the stripper unit for imposing a subatmospheric pressure upon the extract through the well to induce a flow of extract from the subterranean formation through the well to the surface, and into and through the inline stripper.

Claim 15 (Cancelled).

Claim 16 (Original). The apparatus of Claim 12 wherein the inline stripper is configured to cause at least about 80% of the VOC's to be removed from the groundwater to the vapor phase in a single pass through the stripper.

Claim 17 (Previously Presented). The apparatus of Claim 12 wherein the inline stripper comprises a flow through conduit having an inlet into which extract including groundwater flows and an exit from which the vapor and liquid phases pass to the collector and wherein the conduit includes a flow expander section downstream of the inlet through which groundwater from the extract flows and is released into an expanded cross-sectional area such that, upon entering the expanded cross-sectional area, a turbulence, mixing, and misting of the flow is induced to promote separation of the VOC's from the groundwater into the vapor phase.

Claim 18 (Original). The apparatus of Claim 17 further comprising a source of compressed gas connected in flow communication with the inline stripper for introducing a flow of compressed gas into the stripper conduit in the expander section upstream of the expanded cross-sectional area in order to further promote separation of VOC's from the groundwater into the vapor phase.

Claim 19 (Original). The apparatus of Claim 12 wherein the collector comprises a knockout vessel into which material is passed and being configured and dimensioned to promote separation of the liquid and vapor phases by the force of gravity acting upon the liquid phase.

Claim 20 (Original). The apparatus of Claim 12, further comprising a plurality of inline strippers.

Claim 21 (Currently Amended). A method for treating groundwater from a subterranean formation wherein the groundwater is contaminated by the presence of dissolved volatile organic compounds (VOC's) which comprises conducting a flow of a two-phase extract including an undissolved vapor phase and a liquid phase wherein the liquid phase includes contaminated groundwater substantially concurrently through an orifice of a stripper conduit wherein the two-phase extract flow is expanded to promote separation of dissolved VOC's from the liquid phase of the extract groundwater by being rapidly decelerated from a first flow velocity to a substantially lower flow velocity than the first flow velocity in an expanded cross-sectional area of the stripper conduit downstream of the orifice containing a gas space and wherein deceleration of the flow velocity of the extract upon entering the expanded cross-sectional area causes substantially increased turbulence, mixing, and misting of the extract to induce transfer of dissolved VOC's from the groundwater of the liquid phase of the two-phase extract to undissolved gas in the gas space within the expanded area so that the expanded area of the conduit contains a two-phase flow comprising a flowing liquid phase with a reduced VOC content compared to that of the entering groundwater and a flowing gas phase including VOC's transferred thereto from the groundwater entering the expanded area and, thereafter, conducting the flowing liquid and gas phases from the stripping conduit into a collector vessel and effectively separating and collecting the liquid and gas phases into separate and distinct substantially liquid and substantially vapor only flow streams exiting the collector vessel for further treatment and/or disposal.

Claim 22 (Original). The method of Claim 21 wherein the VOC's include methyl tertiary butyl ether (MtBE) and wherein at least a substantial portion of the MtBE is transferred from the groundwater to the gas phase.

Claim 23 (Original). The method of Claim 21 wherein the ratio of the flow velocities of the first flow velocity and the lower flow velocity is from about 1.5 to about 10.

Claim 24 (Previously Presented). The method of Claim 21 further comprising accelerating the flow of extract in the stripper conduit to the first flow velocity from a first relatively lower flow velocity of extract entering the stripper conduit.

Claim 25 (Previously Presented). The method of Claim 21 wherein the flow velocity is accelerated to the first flow velocity by conducting the extract through a reduced cross-sectional area in relation to the cross-sectional area of the stripper conduit in an expander section upstream thereof carrying extract flowing at the first relatively lower flow velocity and in relation to the expanded cross-sectional area of the stripper conduit containing a gas or vapor space downstream of the reduced cross-sectional area.

Claim 26 (Previously Presented). The method of Claim 21, further comprising pumping extract from the subterranean area into the stripper conduit so that extract flowing into the expanded cross-sectional area is under greater than atmospheric pressure.

Claim 27 (Previously Presented). The method of Claim 21, further comprising injecting compressed gas into the extract flowing in the stripper conduit at a location in the conduit upstream of the expanded cross-sectional area.

Claim 28 (Original). The method of Claim 21 wherein the compressed gas comprises compressed air at a pressure in the range of from about 20 to about 150 psig.

Claim 29 (Previously Presented). The method of Claim 21 wherein the compressed gas is supplied at a volumetric flow ratio in relation to the flow of groundwater in the range of from about 10 to about 50 and at a pressure in the range of from about 20 to about 150 psig.

Claim 30 (Original). The method of Claim 21, wherein the ratio of the length of the expanded cross-sectional area portion of the stripper conduit in relation to the cross-sectional area just upstream thereof is in the range of from about 5 to about 50.

Claim 31 (Original). The method of Claim 21, wherein the ratio of the cross-sectional area of the expanded area portion of the stripper conduct in relation to the cross-sectional area of the conduit just upstream thereof is in the range of from about 10 to about 30.

Claim 32 (Previously Presented). The method of Claim 21, further comprising,

following separation of the gas and liquid phases, recycling at least a portion of the separated liquid phase so that recycled liquid phase material is mixed with extract entering the stripping conduit.

Claim 33 (Previously Presented). The method of Claim 32, further comprising conducting at least a portion of the groundwater from the stripper conduit through a second stripper conduit arranged in series, flow communication with the first stripper conduit and further stripping the groundwater in the second stripper conduit.